REMARKS

SECTION 112 REJECTIONS

In the Office Action of October 1, 2007, claim 30 was rejected under 35 U.S.C. §112 first paragraph as failing to comply with the written description requirement. In particular, it was asserted that the limitation in claim 30 of a weighted sum that is computed by forming a weight based on the variance of the noise model could not be found in the specification.

With the present amendment, claim 30 has been canceled and its limitations have been added to claim 14. In addition, the term "variance" has been changed to "covariance." Support for the amendment to claim 14 is discussed below in connection with claim 14.

SECTION 103 REJECTIONS

In the Office Action of October 1, 2007, claims 1, 2 and 5-11 were rejected under 35 U.S.C. §103(a) as being unpatentable over the admitted prior art (hereinafter, APA) in view of Frey et al. (U.S. Patent Publication 2002/0173953, hereinafter Frey) and in further view of Zangi et al. (U. S. Patent Publication 2004/0111258, hereinafter Zangi).

Independent claim 1 provides a method of determining an estimate for a noise-reduced value representing a portion of a noise-reduced speech signal. The method includes generating an alternative sensor signal using an alternative sensor other than an air conduction microphone and converting the alternative sensor signal into at least one alternative sensor vector in the cepstral domain. A weighted sum of a plurality of correction vectors is added to the alternative sensor vector to form the estimate for the noise-reduced value in the cepstral domain. Each correction vector corresponds to a mixture component and each weight applied to a correction vector is based on the probability of the correction vector's mixture component given the alternative sensor vector. An air conduction microphone signal is also generated and the air conduction microphone signal is converted into an air conduction vector in the power spectrum domain. A noise value is estimated and the noise value is subtracted from the air conduction vector to form an air conduction estimate in the power spectrum domain. The estimate of the noise-reduced value is converted from the cepstral domain to the power spectrum domain. The air conduction estimate and the estimate for the noise-reduced value are combined in the power

spectrum domain to form a refined estimate for the noise-reduced value in the power spectrum domain.

The amendments to claim 1 were formed by adding the limitations of claims 7 and 8 to claim 1 and adding references to the cepstral domain and the power spectrum domain. The references to the cepstral domain find support in the specification on page 22, lines 2-4, and page 24, lines 6-19. The conversion of the noise reduced value from the cepstral domain to the power spectrum domain is shown in on page 24, line 25 to page 25, line 6. The references to the power spectrum domain are found on page 20, line 28 to page 21, line 6 and page 25, lines 7-25.

As amended, claim 1 is not shown or suggested in the combination of cited art. In particular, none of the cited art shows or suggests forming an estimate of a noise-reduced value in the cepstral domain, converting the estimate of the noise-reduced value from the cepstral domain to a power spectrum domain, and then combining the estimate of the noise-reduced value in the power spectrum domain with an air conduction estimate.

In the Office Action, it was asserted that Zangi teaches adding a plurality of signal vectors from adaptive filters 74A-74M in combiner circuit 76. However, the AP filter of Zangi does not generate one estimate in the cepstral domain, and then covert it to the power spectrum domain and form another estimate in the power spectrum domain. Instead, all of the filters in Zangi operate in the same domain. In particular, they either all operate in the power spectrum domain.

Further, it would not be obvious to compute one of the values in Zangi in the cepstral domain and then covert it to the power spectrum domain while calculating the other values in the power spectrum domain. In particular, this may cause artifacts to arise since the transfer function for filters 74A-74M is based on the assumption that all of the transfer functions operate in the same domain. (see the equation in paragraph [0103]). In addition, it is easier to set all of the transfer functions in the same domain as shown by Zangi.

Since none of the cited art shows or suggests forming an estimate of a noise reduced value in the cepstral domain, converting the noise reduced value from the cepstral domain to the power spectrum domain and combining the noise reduced value in the power

spectrum domain with an air conduction estimate in the power spectrum domain to form a noise reduced value in the power spectrum domain, claim 1 and claims 2, 5-6, 9 and 11, which depend therefrom, are patentable over the cited art.

CLAIMS 12 AND 13

Claims 12 and 13 were rejected under 35 U.S.C. §103(a) as being unpatentable over Park et al. (U.S. Patent 5,590,241, hereinafter Park) in view of the APA and in further view of Griffin et al. (U.S. Patent 5,701,390, hereinafter Griffin).

Claim 12 provides a method of determining an estimate of a clean speech value. The method includes receiving an alternative sensor signal from a sensor other than an air conduction microphone and receiving an air conduction microphone signal from an air conduction microphone. A pitch frequency is identified for a speech signal based on the alternative sensor signal by identifying which frequency of a group of candidate frequencies is the pitch frequency. The pitch frequency is used to decompose the air conduction microphone signal into a harmonic component and a residual component by modeling the harmonic component as a sum of sinusoids that are harmonically related to pitch. The harmonic component and the residual component are used to estimate the clean speech value by determining a weighted sum of the harmonic component and the residual component.

Support for the amendments to claim 12 are found on page 31, lines 17-30. Forming a weighted sum of the harmonic component and the random component to produce a clean speech value representing a noise reduced signal having reduced noise relative to the noisy air conduction microphone signal as found on page 29, line 22 to page 30, line 2.

In a previous response, Applicants had asserted that the prior art did not show or suggest modeling a harmonic component as a sum of sinusoids that are harmonically related to pitch or of estimating a clean speech value by determining a weighted sum of harmonic component and the residual component. In connection with these statement, Applicants wish to bring to the Examiner's attention U.S. Patent Application 10/647,586 which is submitted

herewith in an Information Disclosure Statement. Although U.S. Patent Application 10/647,586 shows modeling a harmonic component as a sum of sinusoids that are harmonically related to the pitch and determining a weighted sum of a harmonic component and a residual component, U.S. Patent Application 10/647,586 is only available as prior art to the present application under 35 U.S.C. §102(e). Further, U.S. Patent Application 10/647,586 was assigned to the same Assignee as the present application. As such, U.S. Patent Application 10/647,586 is not available as prior art under 35 U.S.C. §103(a) as indicated by 35 U.S.C. §103(c).

As amended, claim 12 is not shown or suggested in the combination of available §103(a) art. In particular, none of the cited art identifies which frequency of a group of frequencies is a pitch frequency for a speech signal based on an alternative sensor signal and none of the available §103(a) art determine an estimate of a clean speech value by determining a weighted sum of a harmonic component and a residual component where the clean speech value represents a noise reduced signal having a reduced noise relative to the noisy air conduction microphone signal.

In the Office Action, Park was asserted as showing the step of identifying a pitch for a speech signal based on an alternative sensor signal at column 3, line 21 because it produces a signal that has primarily low-frequency speech components. However, the cited section makes no mention of identifying which frequency of a group of candidate frequencies is a pitch frequency for a speech signal. Simply producing an alternative sensor signal that has low-frequency speech components is not the same as identifying which of those low-frequency speech components is a pitch frequency for a speech signal.

In addition, none of the references that can be used as §103(a) art show or suggest estimating a clean speech value representing a noise reduced signal having reduced noise relative to the noisy air conduction microphone signal by determining a weighted sum of a harmonic component and a residual component.

In the Office Action, it was asserted that Griffin teaches forming a weighted sum of a harmonic component and a residual component in FIG. 2 where the voiced synthesis and unvoiced synthesis components are added to produce an estimated speech signal. However, the

summation performed in FIG. 2 of Griffin is designed to reproduce the input signal. The entire goal of Griffin is to reproduce the input signal without distorting it anymore than it was already distorted when it is was input. There is no mention in Griffin of forming a clean speech value representing a noise reduced signal having reduced noise relative to a noisy air conduction microphone signal by determining a weighted sum of a harmonic component and a residual component.

In fact, Griffin does not form an estimate of a clean speech value by determining a weighted sum of a harmonic component and a residual component. Although FIG. 2 of Griffin shows an unvoiced component and a voiced component being added together, it is not indicated that this addition is a weighted sum. It appears to be a simple sum, with no weights applied to the voiced and unvoiced portions.

Since the available §103 art does not show or suggest identifying which frequency of a group of candidate frequencies is a pitch frequency based on an alternative sensor signal and because the available §103 art does not show or suggest estimating a clean speech value by determining a weighted sum of a harmonic comment and a residual component, the combination of available §103 art does not show or suggest the invention of claim 12 or claim 13 which depends therefrom.

<u>CLAIMS 14, 15, 17, 18, 23, 24, AND 29</u>

Claims 14, 23, 24 and 29 were rejected under 35 U.S.C. §103(a) as being unpatentable over Park in view of Zangi and further in view of Frey. Claim 15 was rejected under 35 U.S.C. §103(a) as being unpatentable over Park in view of Zangi and in further view of APA. Claims 17 and 18 were rejected under 35 U.S.C. §103(a) as being unpatentable over Park in view of Zangi and in further view of Frey.

Claim 14 provides a computer-readable storage medium storing computer-executable instructions for performing steps. The steps include receiving an alternative sensor signal from an alternative sensor that is not an air conduction microphone, receiving a noisy test signal from an air conduction microphone and generating a noise model from the noisy test

signal. The noise model includes a mean and a covariance. The noisy test signal is converted into at least one noisy test vector and the mean of the noise model is subtracted from the noisy test vector to form a difference. An alternative sensor vector is formed from the alternative sensor signal. A correction vector is added to the alternative sensor vector to form an alternative sensor estimate of a clean speech value. A weighted sum of the difference and the alternative sensor estimate is set as an estimate of the clean speech value, wherein the weighted sum is computed using the covariance of the noise model to compute weights for the weighted sum.

Support for the amendment to claim 14 is found on page 25, lines 6-25. As shown in EQ. 10 of that section, a weighted sum is formed from the difference between a noisy air conduction microphone signal and a mean of a noise model and an initial clean signal estimate based on an alternative sensor. The weights applied to each of these terms is based on the covariance Σ_n of the noise model.

As amended, claim 14 is not shown or suggested in any of the cited art. In particular, none of the cited art shows or suggests a weighted sum that is computed using the covariance of a noise model to compute weights for the weighted sum. In the Office Action, Zangi was cited as showing setting a weighted sum of a difference and an alternative sensor estimate to form an estimate of a clean speech value. However, Zangi does not show or suggest computing the weighted sum using the covariance of a noise model to compute weights for the weighted sum.

Since none of the cited references show or suggest setting a weighted sum as an estimate of a clean speech value where the weighted sum is computed using the covariance of a noise model to compute weights for the weighted sum, the combinations of cited art do not show or suggest the invention of claim 14 or claims 15, 17, 18, 23, 24 and 29, which depend therefrom.

CONCLUSION

In light of the above remarks, claims 1, 2, 5, 6, 9, 11-15, 17, 18, 23, 24 and 29 are in form for allowance. Reconsideration and allowance of the claims is respectfully requested.

The Director is authorized to charge any fee deficiency required by this paper or credit any overpayment to Deposit Account No. 23-1123.

Respectfully submitted,

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